MEMORANDUM

17 January 1984

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Subject: Power Line Network Program

FYI
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I asked Greg Sloat (CEC), who runs our Power Line Network (PLN) Program, to explore a few scenarios dealing with how the PLN could solve specific problems. His reply is attached. I believe that we need to do more scenario-based thinking, such as this, to complement market studies.

One of the problems of marketing studies is that it is difficult to express or, in some cases, recognize a need if you can't envision a solution.

George Heilmeier/mg

Attachment
Power Line Network Business Scenario

File: Powerline Network

POWER LINE NETWORK

BUSINESS SCENARIO

GREG SLOAT

JANUARY 11, 1984

Business Scenario for the Power Line Network

Purpose:

The purpose of this report is to informally discuss how TI can make a successful business of power line related communication/control products.

Putting Intelligence on the AC Power Line

There are three kinds of products that utilize the AC line to transfer intelligence:

Appliance Control - These products consist of a low bit rate transmitter that can access up to 16 special switch modules or light dimmers.

Transmitter cost ranges from $35 to $99 depending on the bells and whistles. Each receiver module (switch or dimmer) retails in the $14 to $30 range.

Key Points:

1) Line modulation consists of 100 KHz bursts keyed to the 60 Hz line in such a way as to limit the bit rate to 60 bits/sec.

2) These products work very well for the purpose intended and are highly integrated.

3) This transmission technique produces severe RFI and has survived the FCC only because it transmits very briefly when the on or off button is pressed.

AC line modems - utilize full duplex FSK (Frequency Shift Keying) to transmit/receive up to 9600 baud digital data. The two center frequencies involved are typically 105 KHz and 155 KHz. These modems handle RS-232 protocols and are priced in the $180 range; thus, it costs $360 to connect two devices via the AC line.

Key Points:

1) There are only two competitive AC line modem products on the market and only one, the CRC LCM-100, works well enough to be a viable product.

2) Only one transmitter and receiver can be used on a given AC circuit. (The technology could be expanded to provide, say, four channels).

3) Existing units cannot coexist on the AC line with a BSR-type appliance control transmitter.

4) Although not as bad as the appliance control transmitter, the AC line modems produce considerable conducted RFI.

Power Line Network - Allows up to 254 devices to interconnect on the same AC circuit and provides up to 9600 baud data transfer. There are no competitive network products that use the AC line as the communication medium. Existing low-end networks cost about $400 per node with additional up-front expenditures for system hardware and special wiring. The TI PLN will ultimately be priced below $100 per node and require no special wiring.

Key Points:

1) The difference between AC line modems and a power line network is analogous to the difference between a pair of interconnected field telephones and a system of telephones interconnected through an exchange.

2) The CEC approach requires only half-duplex communication, operating at 262 KHz, and can tolerate appliance control signals on the same AC line.

3) The TI PLN hardware can be sold through the same channels that sell the TIPC. Since no special cables are needed, installation of the network can be handled by the user.

The Market Environment

Controlling appliances via the AC line is almost fifteen years old. BSR pioneered this effort in the consumer market and now private labels to Sears, Radio Shack and others. The tough technology in the appliance control area is not the AC line communication technique, but the reliability and safety of the switches (and dimmers) that directly control the appliances. BSR has paid heavy dues in this area and their latest line of receiver modules (switches) seems to be reasonably reliable and safe.

Although these appliance control devices have been around a long time, they are just beginning to get the attention of the consumer, as evidenced by the rash of new products on the market (all based on the BSR technology).

General Electric has made a big splash in the past year with their Homenet concept. A tiny piece of the Homenet is the control of appliances and G.E.'s approach, although similar to the BSR approach, is not compatible with BSR and will require different receiver/switch hardware. As far as we can tell, the G.E. Homenet is a paperwork exercise and no hardware exists. In fact, the specification that we reviewed is only 25% complete. There are several elements of the G.E. Homenet that lead us to believe that it could not be successful in its present form:

* It is a very complex multilevel network with rather poor performance potential.

* It places all of the network protocol burden on the user equipment, (i.e., the user equipment will require special programs to operate on the network).

* G.E. states very clearly that if any user equipment needs the network more than 1% of the time, the Homenet should not be considered.

* AC line communication is a small part of the Homenet concept. The bulk of the data transfer will require twisted pair. The power line will only serve for appliance control.

PC prices have come down to a point where even small companies can afford computing power. The usefulness and cost effectiveness of a PC is increased many fold if it can share data and peripherals with other computers. Data networks in the late 80's will play almost as important a role in the information explosion as the computer itself.

Before the days of the personal computer, large companies needed data networks to tie terminals and peripherals to large mainframe computers. With PC's starting to displace dumb terminals, the need for data networks continues to grow. One of the key factors in the success of the IBM PC is the whole multilevel data network structure that allows the PC to communicate to other IBM equipment.

The same factors that made it worthwhile for a large company to spend hundreds of thousands of dollars on a data network, exist in smaller companies that cannot tolerate that level of expense. Lower cost data networks have been developed to provide network services to moderate size companies. These networks cost several thousand dollars plus $400-$800 per node.

Our major interest is in small businesses, offices, schools and homes. Even low end data networks are too expensive for most of these areas, yet the same needs exist (or will exist), just on a smaller scale. People in these market segments are much less sophisticated than those in large industries and will require very basic education before they understand how to use present and future information technology.

Example: A three-man law office in Dallas has purchased a word processing system and it resides in the secretary's area. A lawyer prepares the first draft of a client's will by having his secretary merge boilerplate files on the word processor. Modifications of the boilerplate require either that the lawyer sit in the secretary's area to make the changes or write detailed instructions to the secretary. The same thing happens again when the client returns to finalize the will. The lawyers can't afford four word processors, and didn't realize that they could have access to the word processor from a low cost terminal or PC, from each of their offices. One lawyer commented that he had an urge to buy a PC, but couldn't think of a

way to justify the purchase. Once he understood that the PC could communicate with the word processor, he immediately bought the PC.

The lawyer in the above example made a very interesting statement: he said "It would never have occurred to me to ask if a PC could talk to a word processor - I didn't know that computers could do that sort of thing." It is difficult to express (or even recognize) a need if you can't envision some way to satisfy it.

PLN Application Scenarios

* Boss and secretary sharing correspondence files and a single printer in a small office.
* Partners in a small business sharing business data.
* Lawyers accessing their word processors from their offices.
* Doctors/nurses/secretaries sharing patient information.
* Access in each office to centralized legal and medical data bases.
* Sharing of order entry and credit information in small offices.
* Sharing of engineering information in consulting offices.
* Centralized tutoring of several students within one classroom.
* Private communication that bypasses the telephone system in small offices.
* Downloading games and educational software from one home computer, with disk drive, to a console-only computer in the kid's room.
* Two or more computers sharing a printer in the office or home.
* Downloading of data into public access terminals where special cables are impractical, i.e., bank lobbies.
* Communication between the stock room and shop in very small industries.
* Communication between the stock room and inventory control function in small companies.
* Large company applications
    - Large clerical-intensive office areas that need strong intra-office communication with minimal need for data communication to the outside world.

- Simple communication between boss, secretary and administrator where the expense of a major network hookup can't be justified.

Note: A very practical, cost effective way to use the PLN is to interconnect terminals/PC's within a function via the PLN and to have one of those terminals also connected to the major network to provide one a high speed link to other functions.

- Areas where a low cost "private" network provides better service than a super network because the major network is overloaded.

- Areas where major network downtime can't be tolerated.

- Outposts that are not served by a major network.

Note: In many of the large company applications for the Power Line Network, modifications of the power system to ensure that the required outlets are on the same transformer may be a very cost effective way to provide network capability.

* Future Uses

- Although we have disengaged with Puget Power because of the demise of the 99/4A, the energy management ideas that were part of that program plan are going to happen, and AC line control of appliances is the only viable approach. The power line control IC business alone could be very large.

- From the beginning of the PLN program, we have said that there will not be a strong need for a data network in the home until the early 90's, but when that need does exist, it will be a very large business.

- An infrared data link into the PLN could be provided as a peripheral product allowing keyboards and other equipment to be truly portable within a room.

- For every PLN application that we have thought of, there are probably two that we haven't thought of. Ultimately, our customers will be smarter than we are!

PLN Recommended Actions for 1984

The Ethernet capability, being supported by the TIPC, is important for the mid to large office market environment and even the small office environment when the rapid transfer of large data bases is a requirement. We think that the Power Line Network will be equally important to serve small offices and

will fit many applications in larger offices that fall outside of the needs for a major network.

By early January, the CEC initial power line network design will be complete. By the end of February, we will have built 20 network nodes. These units will serve to demonstrate the Power Line Network and to provide test units that can be used in a "real world" environment. Most of these units will be packaged for the TIPC because of the excellent demonstration potential. It is our hope that these units will spark the interest of the TI computer products market planning people. We have sent copies of the PLN specification to DSG in preparation for discussions early in 1984.

A discrete design could be implemented in the TIPC and be in production in the third quarter of '84. Although more expensive than the integrated version, it would get our feet wet in the marketplace very quickly. An integrated, cost reduced version could follow in 8 to 12 months.

While the 20 prototypes are being built and tested, the CEC engineering staff will be available to help the programmable products group define an appliance control strategy and circuit design for the control transceivers. Initially, this work would center around one outside customer's needs, but we would want to sell an approach that had wide industry appeal and with the goal of producing an industry standard. Although not well defined at this time, it is not unreasonable to assume that the development work could be completed in the third quarter with IC's being available in the second quarter of 1985. Having the full Power Line Network available for demonstration should make it easier to sell the TI appliance control philosophy and if potential customers of the Power Line Network know that they can add energy management capability to the network within a year, we have the leverage to be the leader in power line technology.